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STRUCTURED APPROACH TO LAND ISSUES THROUGH SES ELEMENTS

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Abstract

In order to respond to economic, social and environmental challenges, societies need sound and reliable information about their resource "land". The foremost important data set – before taking any strategic or operational decisions – is about who owns a particular piece of land. Such information is to be provided by well-organized and efficient systems such as land registration and cadastre, which are core elements of a "land administration" system. Land administration systems themselves can be considered as the basic documentation layer serving "land management" with relevant information to carry out land related activities such as land-use planning, land consolidation and other land related implementation policies. Landownership information in this context is very crucial as things always happen on somebody's land; land ownership is not the sole information though, but it is more often than not at the core of the solution.

In order to take benefit on a macro-economic level of spatial or location-based information, data needs to be organized in such a way that it can be integrated and shared among stakeholders. Interoperability is key to make best use of geographic information. This can be achieved by establishing a spatial data infrastructure, which observes three conditions that will allow it to be operated in either a centralized or decentralized federated environment.

1. Motivation and Background

The global society is increasingly observing phenomena such as urban sprawl, overpopulation, pollution, traffic congestions, inefficient transport systems, disaster management, land grabbing, or environmental sustainability. In order to manage, handle, and solve such issues, basic information including the geographic location is required.

The rapid development and increased demand for geographic information have made "spatial data infrastructure" (SDI) an invaluable tool in policy formulation and evidence-based decision making. Geographic information and technology is proving to be an effective tool in addressing complex and multi-scale challenges. The notions of "spatial enablement" and "spatially enabled society" are a reference to the use of spatial technology across all levels of society – government, industry and citizens – to improve decision-making, transparency and increase efficiency.

The ability to add location to almost all existing information can unlock a wealth of existing knowledge about social, economic and environmental matters. This knowledge is playing a vital role in understanding and addressing the many challenges we face in a gradually more complex and interconnected world. Increasingly, we refer to this as "spatial enablement", which requires information to be collected, updated, analyzed, represented, and communicated, together with information on land ownership and custodianship, in a consistent manner. This mainly with the aim to underpin good governance of land and its natural resources, whole-of-government efficiency, public safety and security towards the well-being of societies, the environment and economy.

2. Spatially Enabled Society

2.1. Role in Government and Society

Spatial enablement is a concept that adds location to existing information and thereby unlocks the wealth of existing knowledge about the land, its legal and economical status, its resources, potential use and hazards. Spatial enablement uses the concept of place and location to organize information and processes and is now a ubiquitous part of e-Government and broader government ICT strategies (compare Figure 1). Information on landownership is thereby a basic and crucial component to allow for correct decision-making. Such data and information must be available in a free, efficient, and comprehensive way in order to support the sustainable development of society. It therefore needs to be organized in such a way that it can easily be shared, integrated, and analysed to provide the basis for value-added services.

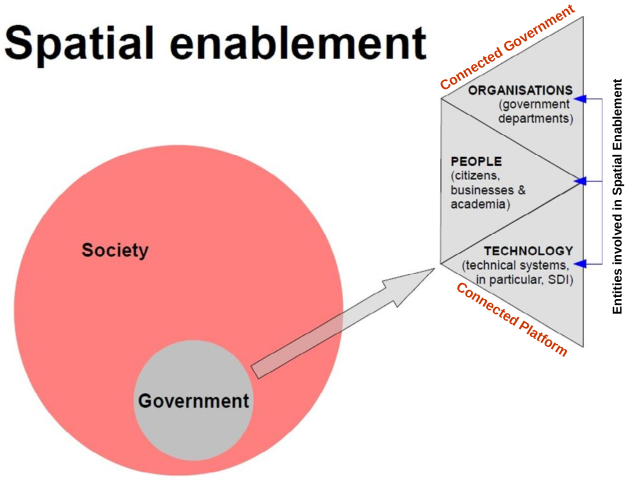

Figure 1: Concept of spatial enablement and how it relates to social and technical systems within a society (adapted from Holland et al., 2009).

However, the concept of a "Spatially Enabled Society" (SES), and inherent to this, the concept of Spatially Enabled Government (SEG), has gained momentum internationally as jurisdictions begin to recognize the benefits it delivers. This can be seen in the number of conferences, symposiums, and numerous activities that have been organized around the theme of spatial enablement. SES and SEG are now part of the objectives of governments in many countries, highlighting the importance of spatial information and strategies in policy development and decision-making in the public sector. SEG increasingly operates in a virtual world, but SEG initiatives need to be coupled with real world institutional and structural reforms in the use of spatial information and spatial data infrastructures as an enabling platform.

Therefore, a society can be regarded as spatially enabled when location and spatial information are commonly available to citizens and businesses to encourage creativity and product development (Wallace et al., 2006), and it is also defined as an innovator and enabler across society and a promoter of e-Democracy.

Spatial enablement, and therefore SES, should be regarded as an evolving definition. Similar to other emerging concepts, there are different views on spatial enablement but essentially it requires data, and in particular, services, to be accessible and accurate, well-maintained and sufficiently reliable for use by the majority of society which is not spatially aware.

2.2 Six Key Elements

In order to support the SES and SEG concepts, an FIG Task Force (Steudler and Rajabifard, 2012) identified six elements, which are critical to its implementation. Without those six elements, the spatial enablement of a society or government would seriously be held back in its progress. They are:

Legal framework: to provide a stable basis for the acquisition, management, and distribution of spatial data and information;

Common data integration concept: to facilitate that existing spatial data – from government as well as other sources – respect the common standards in order to ensure interoperability for the benefit of all;

Positioning infrastructure: to provide a common geodetic reference framework in order to enable the integration of spatial data and information;

Spatial data infrastructure: to provide the physical and technical infrastructure for spatial data and information to be shared and distributed;

Landownership information: to provide the updated and correct documentation on the ownership and tenure of the land, fisheries, and forests, without which spatial planning, monitoring, and sound land development and management cannot take place;

Data and information concepts: to respect and accommodate the different developments in the acquisition and use of spatial data and information.

In terms of keeping a society spatially enabled, there are probably further issues that need to be considered, namely the educational framework, the technical and institutional development of spatial data management, the development of awareness on all levels of society – such as citizens, institutions, and decision-makers – and the development and applicability of land management tools in order to make best use of spatial data. These elements, however, are not further discussed here.

3. Common Data Integration Concept

In order to take benefit on a macro-economic level of spatial or location-based information, data need to be organized in such a way that it can be integrated and shared among stakeholders. Interoperability is key to make best use of geographic information. This can be achieved by establishing a spatial data infrastructure observing three conditions that will allow it to be operated in either a centralized or decentralized federated environment.

3.1 First condition: Respecting the Principle of Legal/Institutional Independence

A first condition to design an integration-friendly structure is fulfilled **when the geodata representing spatial objects subject to the same law and underlying a unique adjudication process are arranged in separate data domains**.

This type of arranging the data topics is called the principle of "legal/institutional independence". This principle allows the design of a model corresponding to the allocation of the responsibilities as defined by the legal framework.

The legal framework assigns the responsibility for the data domains to a particular authority. Those authorities are the data owners and are responsible for the collection, updating and management of certain spatial data domains. Data ownership is not altered by the introduction of a model with legal/institutional independence. They are therefore not divested of their initial responsibilities and keep the full control of the data domains for which they are declared to be responsible (compare Figure 2).

With this arrangement the allocation of the responsibilities corresponds to the laws and regulations. In addition each data owner has access to the data sets of the other stakeholders. All the users of this model can use the information for their work and decision-making. There is no need to deliver information to other stakeholders or to receive copies of data of other data owners.

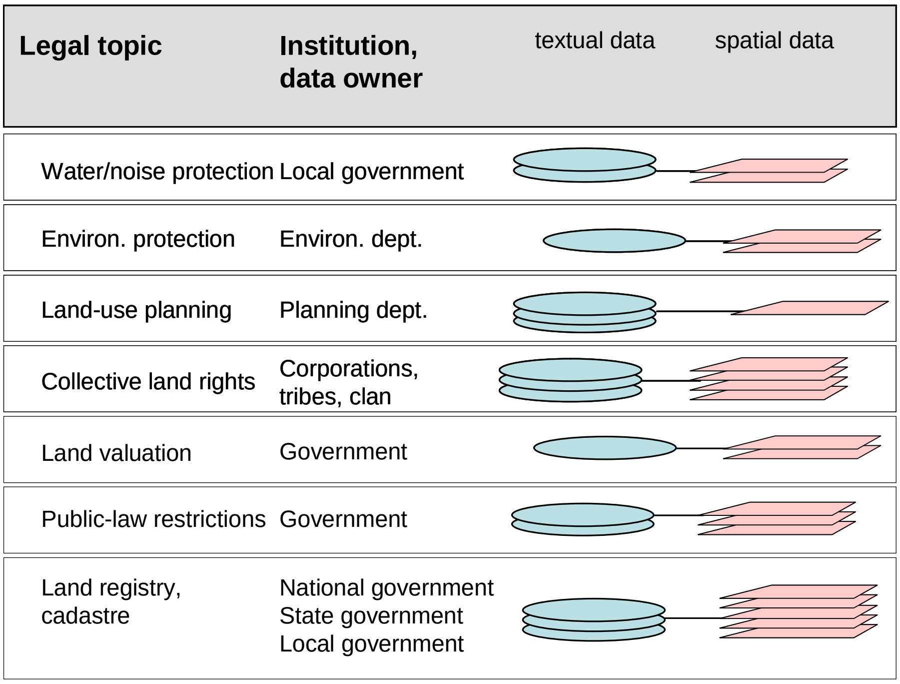

Figure 2: Legal/institutional independence, where the different stakeholders can manage their data sets independently from outside interference.

3.2 Second Condition: Use of Same Geographic Reference Framework

The second condition is the use of the same geographic reference framework for all spatial data that will need to be shared. With this, it becomes possible not only to manage all data in common systems, but also to rely on the geographic location as the sole logic link between independent land objects. It will be possible to store and maintain geographic information without explicit care of the logic relation between objects. The use of localization algorithms – e.g. drilling through the information layers – instead of logic relations makes the data model lean, flexible and efficient. The relation between objects is established only when required.

3.3 Third Condition: Use of a Common Standardized Data Modeling Concept

The third condition is the use of a common and standardized data modeling concept, which is useful for the description and exchange of data and information. This conceptual element has been reinforced by the recently adopted ISO standard of the Land Administration Domain Model (LADM), which provides basic principles for establishing data models for land tenure systems. The standardized data modeling concept ought to be used for all other information domains of local, national or regional SDIs enabling full interoperability between information topics.

The aspect of data modelling is crucial for the concept of a SES. For a long time, the map was the traditional model of spatial reality. If the data was represented according to the drafting rules for map production a model represented on paper emerged. The map was at the same time data storage and representation medium in one. In a data-centred solution, maps or drawings will serve simply to represent information derived from data stored in data bases. The storage media is no longer the map, but the data bases.

This means that the two functions of the paper map are now divided into two parts. The data base must be modelled according to the logic of data processing. The representation of the data by means of drawings makes it easier to understand the content of the data bases and to interpret an existing or planned situation. The representation is modelled with a representation model according to the needs of the viewers.

Data and representation description are to be IT-friendly. Data and their structure are described with something akin to a programming language. The best solution is an interpretable data description language readable by a computer. Thus data bases can be designed by intelligent software and data can be checked automatically. Representation models shall be IT-friendly as well. They serve to compile machine-aided representations.

Unless a society is able to change from a map to a model paradigm, it cannot be considered to be spatially enabled.

3.4. Summary

It is beneficial for a national SDI when a common data integration concept is adopted at an early stage. This allows for the early introduction of a future interoperability and linkage of data sets. It is crucial to overcome isolated data silos, which requires a strong commitment and communication among the potential players within an SDI or SES.

The mentioned elements seem to be rather technical and to focus mainly on developed countries. They need, however, to be discussed on a conceptual level and can and should be applied by developing countries as well, because the concept is basic enough to be tailored.

When the three conditions are respected, it will become possible for the different stakeholders in a spatially enabled society to provide their data into a common spatial data infrastructure. There those data sets can be used and shared in an interoperable way by all others, for the benefit of the whole society (see Figure 3).

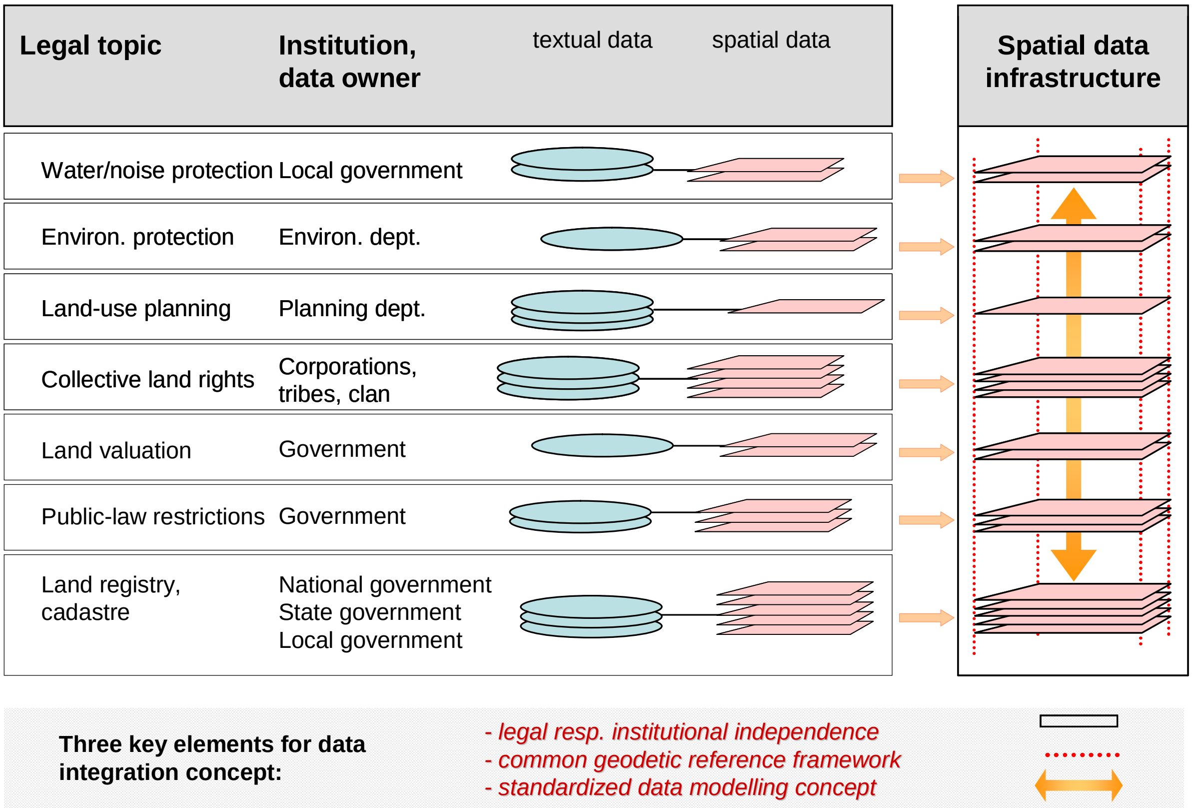

Figure 3: Three key elements for the data integration concept: legal/institutional independence, common geodetic reference system, and standardized data modelling concept.

4. Land Ownership Information

The following text is taken from van der Molen (2012) and illustrates the importance of land ownership information as one of the key elements in a spatially enabled society.

In many interactions between government, businesses and citizens, data about land ownership is of a dominant presence. This is in line with Steudler and Rajabifard (2010), who say that a prerequisite to achieve spatial enablement is the modelling of the real world: a crucial element in dealing with global problems is the spatial information regarding landownership, as a cadastre is crucial for establishing the link of people to land.

Examples of interactions between government, businesses and citizens in the domain of landownership concern land tenure and land tenure security, and market, mortgage market, land taxation, urban and rural land use planning, managing and upgrading informal settlements, management of state owned land, resolution of land conflicts, large scale investments in agriculture, land “grabbing”, adaptation to and mitigation of climate change, gender equity when assessing land ownership, protection of indigenous land rights, land ownership and land use in disaster prone areas (for the latter see Mitchell, 2010).

Because the history and culture of countries is different, it is necessary to define how to understand 'land ownership'. Referring to the definition of land administration by the UN (1996), which is "the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies", it encompasses information about ownership, value and use of land. Broadening this to a global relevance, 'ownership' includes any relationship between people and land whether statutory or non-statutory (customary, social, informal), 'value' includes value for any purpose (market, taxation, credit, expropriation, carbon credit etc) and 'use' might include use for any purpose (land cover, given land use). Defining "ownership, value and use of land" in this broad sense, we seek assurance that this FIG report encompasses all countries in the world. This broadening also sheds light on the use of the word 'cadastre' as being "central to the concept of spatial enablement" (Williamson and Wallace, 2006; Williamson et al., 2010a). This might be true when 'cadastres' are available in a country; other countries might also derive 'landownership' information from other sources, such as social tenure information systems, other land information systems, or any collection of relevant data that can be useful (see also Uitermark et al., 2010).

Land ownership is connected with 'place', as it concerns ownership, value and use of a defined lot of land. This lot of land can have various spatial dimensions, from a single point value (for example the centroïd of the specific lot) to an accurate representation of the whole lot (through a land survey of its boundaries).

Whatever spatial representation is chosen in a country, the average and normal case is representation of the whole lot through the 'cadastral parcel', although the concept of 'parcel' in Cadastre 2014 is broadened by 'cadastral object', extending private law parcels to private and public law 'objects', in response to the increasing number of land rights, which are based on public law (such as restrictions, zoning areas, natural resource areas) because of increasing government interventions in private law rights.

As the nature of cadastral parcels is that they are uniquely defined, making them suitable to serve as the place or location data element in an SDI independent from the technical advance of the spatial reference (from the single point to accurate boundaries).

An example at European level is the implementation of the EU Directive 2007/2/EC establishing an infrastructure for spatial information in the European Community called Inspire (Tonchovska and Adlington, 2011). The cadastral parcel finds itself defined as a core element of Inspire, for which the specifications were developed by a technical working group of the distinguished national organisations responsible for cadastre and land registration grouped in EuroGeographics and the Permanent Committee on the Cadastre PCC (Martin-Varés and Salzmann, 2009). The data specifications are now assigned as official guideline (Inspire document D2.8.1.6).

5. Discussion and Examples

The development of a society towards spatial enablement can be thought of as a continuum over several steps, which may happen for each key element at different speed. When a society has attained full spatial enablement, decision-making procedures may become feasible, which were not possible before. The following two examples illustrate what this might be.

A first example shows how the cadastral landownership layer can be complemented with mortgage and foreclosure information. Such information can then be aggregated at a state or national level, which allows detecting patterns or clustering phenomena. The spatial representation of such phenomena can serve important political decision-making processes (see Figure 4).

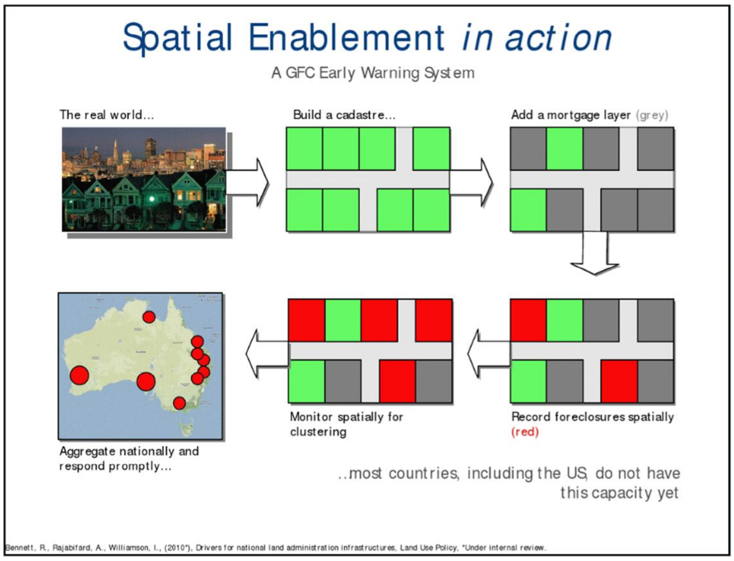

Figure 4: Spatial enablement in action (from Bennett et al., 2012).

Another example is a project in Switzerland, where a web-based portal is being developed for farmers to declare their annual cultivation areas online. Farmers are receiving subsidies on the basis of the crops and areas that they are cultivating. Based on the cadastral landownership and an orthophoto layer, the portal offers tools such as easy-to-use snapping functions and standard forms to be filled out (see Figure 5). This will allow a much more direct and efficient notification process for farmers to provide their data and receive their subsidies. Such a solution would not be possible without a complete documentation of landownership and the interoperability of the information, both of which are in place in Switzerland.

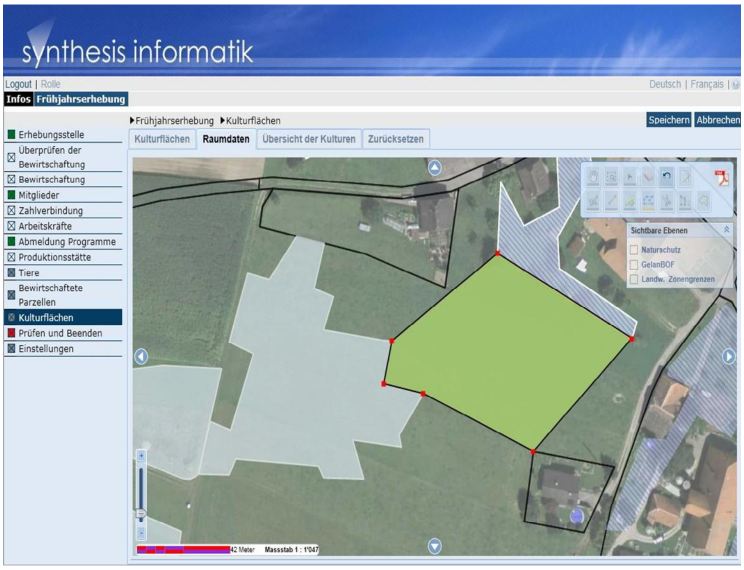

Figure 5: Prototype of web-based tool for farmers indicating their cultivation areas for annual subsidies. © Synthesis Informatik, Gümligen, Switzerland, www.syn.ch.

References

Bennett, R., Rajabifard, A., and Williamson, I.P. (2012). On recognizing land administration as infrastructure for the public good. Journal of Land Use Policy (accepted in February 2012-In Press).

Holland, P., Rajabifard, A. and Williamson, I. (2009). Understanding Spatial Enablement of Government. Proceedings of the 2009 Spatial Sciences Institution Biennial International Conference, 28 Sep. to 2 Oct., Adelaide, South Australia.

Kaufmann, J. and Steudler, D. (1998). Cadastre 2014 – A Vision for A Future Cadastral System, with working group 7.1 FIG Commission 7, 51p., <www.fig.net/cadastre2014>, last accessed on 17 Mar. 2012.

Martin-Varés, A.V. and Salzmann, M. (2009). The Establishment of the Cadastral Parcel as a Core Element in the European SDI. Proceedings GSDI-11, Rotterdam, the Netherlands.

Mitchell, D. (2010). Land Tenure and Disaster Risk Management. FAO Land Tenure Journal 1-10.

Steudler, D. and Rajabifard, A. (2010). Spatially Enabled Society – the Role of Cadastres. FIG-Congress, Sydney.

Steudler, D. and Rajabifard, A., eds. (2012). Spatially Enabled Society. Joint publication of FIG-Task Force on Spatially Enabled Society in cooperation with GSDI Association and with the support of Working Group 3 of the PCGIAP. FIG Publication No. 58. <http://www.fig.net/pub/figpub/pub58/figpub58.pdf>, last accessed on 20 Feb. 2013.

Tonchovska, R., and Adlington, G. (2011). Spatial Data Infrastructure and INSPIRE, a Global Dimension. FAO Land Tenure Journal 1.

Uitermark, H., van Oosterom, P., Zevenbergen, J., and Lemmen, C. (2010). From LADM/STDM to a Spatially Enabled Society. Proceedings World Bank Conference of Land Policy and Administration Washington 2011.

UN (1996, revised 2005). Land Administration Guidelines. New York Geneva.

van der Molen (2012). Land Ownership Information in a Spatially Enabled Society. In: Steudler and Rajabifard, eds. Spatially Enabled Society.

Wallace, J., Williamson, I., Rajabifard, A., and Bennett, R. (2006). Spatial Information Opportunities for Government. Spatial Science Journal, Vol 51 (1), pp. 79-99.

Williamson, I. and. Wallace, J. (2006). Spatially Enabling Governments: A new direction for LAS, Proceedings FIG-Congress, Munich.

Williamson, I., Rajabifard, A., and Holland, P. (2010a). Spatially Enabled Society. Proceedings FIG-Congress, Sydney.

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